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Biography

Professor John Share-Jones, D.V.Sc., F.R.C.V.S.

DR. SHARE-JONES was born at Cefn in North Wales and educated at King's College, University College (North Wales), of which he is now a Governor, and the Royal Veterinary College, London. From the latter he graduated as M.R.C.V.S. in 1900, being appointed Tutor in the Department of Surgery and afterwards Demonstrator of Anatomy. From this post he transferred to the Liverpool University Veterinary School, being appointed to the Professorship of Veterinary Anatomy, and eventually becoming Director of Veterinary Studies.

His other University activities include Examinerships to the Universities of London, Edinburgh, and Aberdeen for the respective degrees of M.B., B.Sc. (Science and also Agriculture) and the D.V.H., so that his career has been an eminently scholarly one ; whilst his numerous contributions to the literary world include an illustrated Surgical Veterinary Anatomy (four volumes), chapters on Veterinary Science in the " Encyclopædia Britannica," and many articles too numerous to mention on Animal Husbandry and Agricultural education.

The two latter subjects have been an especial study of Professor Share-Jones and his poignant speeches on these subjects at political and other meetings have attracted much attention in the daily Press.

For a long time the members of the veterinary profession have felt the need of direct representation in the House of Commons, and at the present moment there seems a reasonable prospect that this hope may be fulfilled, for Professor Share-Jones has been adopted as the Liberal candidate for the Oswestry Division of Shropshire, a seat rendered vacant by the retirement of the Rt. Hon. O. C. Bridgeman. At the present moment, what with the presidential duties and political efforts, it requires no great amount of imagination to be aware that he is a very busy man ; and in his efforts to enter Parliament Dr. Share-Jones may rest assured that he has not only the eyes of the whole profession upon him, but that he also carries with him their best wishes for the successful attainment of the task which he has undertaken on their behalf.

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Editorial

AN IMPERIAL RESEARCH INTO ANIMAL DISEASES.

ABOUT a year ago a very important Imperial Agricultural Research Conference was held in London, being attended not only by Agricultural Scientists, but by Veterinary Heads of Government Departments from all over the world.

As the sequel to this it is proposed to establish eight new Bureaux, or Clearing Houses of information, attached to existing research institutes, and the governing committees of these have expressed their approval of the scheme.

The subjects which it is proposed to bring forward, together with the several places of study, and their respective directors, are :—

Soil Science, Rothamsted Experimental Station, Harpenden, Herts (Sir John Russell).

Animal Nutrition, Rowett Institute, Bucksburn, Aberdeen (Dr. J. B. Orr).

Animal Health, Veterinary Research Laboratory, Weybridge (Dr. W. H. Andrews).

Animal Genetics, Animal Breeding Research Department, Edinburgh University (Professor R. A. Crew).

Agricultural Parasitology, Institute of Agricultural Parasitology, near St. Albans (Professor R. T. Leiper).

Plant Genetics (for crops other than herbage plants), Plant Breeding Institute, Cambridge (Professor Sir Rowland Biffen).

Plant Genetics (for herbage plants), Welsh Plant Breeding Station, Aberystwyth (Professor R. G. Stapleton).

Fruit Production, East Malling Research Station, Kent (Mr. R. G. Hatton).

An Agricultural and Veterinary Research of this kind cannot fail to do good work, and we commend it to the attention of our intending graduates as an interesting professional outlet with a prospective future not only financially, but in the world of science and original opportunity.

General Articles

AN EMPIRE VETERINARY SERVICE.

By LT.-COLONEL H. A. REID, O.B.E., F.R.C.V.S., D.V.H., F.R.S.E.

A CLOSER union of the British Empire is an ideal toward which we are steadily progressing, and it is not merely a federation of states, but a federation of hearts to which we must aspire. We must learn to think in terms of that vast and widely distributed population related by ties of kinship and mutual interests, and our policy must be one which shall serve these people, and lead ultimately to the development of a self-supporting dominion whose unlimited resources shall provide opportunities for all who dwell within its territories.

Anything, therefore, which may assist us in this aim should claim the attention not only of the avowed protagonists of the British Empire movement, but of every British subject. With this object in view we should strive to encourage greater co-operative effort and a better co-ordination in the work of the various services throughout the Empire. With a suitable organisation much of the energy at present expended in wandering through paths which have already been thoroughly explored might better be conserved.

Without detracting from the value of independent inquiry, especially when local conditions have to be taken into account, it would seem an advantage to those engaged upon a common task to have at their disposal the experience derived from the painstaking labours of others similarly occupied elsewhere.

Up to the present this need has been partially met by reference to reports and contributions published in the many scientific journals, or by correspondence with contemporary workers in various parts of the world. To anyone who has undertaken scientific investigation in the more remote portions of the Empire the inadequacy of the assistance obtainable through these channels will be appreciated. Too often the investigator will sooner or later find that at the cost of much time and money, he has been traversing a furrow which has already been turned. In the interests of those concerned, and particularly on the grounds of greater efficiency and economy, a scheme for co-ordinating the work of our widely scattered forces should be devised.

At the present time International Research as applied to the study of foot-and-mouth disease has been discussed, and at the second meeting of the Committee of the International Office of Epizootics

held at Paris in May last, the following resolution was moved by the representatives of France and Germany :—

> " That the Committee of the International Office of Epizootics should encourage frequent intercourse and exchange of opinions between scientists, especially those engaged in various countries in the study of foot-and-mouth disease, which would be of advantage to them in their researches. That interested governments should support these relations and that they should even consider the possibility of the international exchange of research workers, and, finally, that the International Office of Epizootics, as soon as provision could be made, should contribute, if necessary, to this object."

It is evident that such collaboration, through the pooling of individual experiences, might lead to important results. Treated from an international standpoint difficulties might arise. But it is quite practicable to contemplate a corresponding arrangement applicable to research workers throughout the British Empire having as their aim the interests of the Empire as a whole.

The valuable information resulting from observations carried out by veterinary staffs in the field does not perhaps receive sufficient recognition. The laboratory worker himself should avoid cultivating a too academic attitude of mind. He should at least have had considerable experience of the practical difficulties which have to be overcome. There is perhaps a tendency on the part of the one to confine his attentions to the microscope and test tube, and on the other to act merely as a reporter and collector of pathological material. Both require to observe a sympathetic relationship.

How can our graduates best be trained to render their services of value to the Empire ? There can be little doubt that the curriculum provided at our veterinary schools now stands in need of revision if not reconstruction. It is not sufficiently comprehensive for modern requirements.

Whether it will be necessary to extend the diploma course to five years in order to effect the changes which appear to be necessary is admittedly a controversial question.

On reference to the calendar of the Ontario Veterinary College we find included in a four years' course such subjects as Bio-chemistry, Animal Husbandry, Civics and Economics, Public Speaking and Journalism. The importance of some of the subjects mentioned may be open to criticism. Though the field of education can never be too wide, the difficulty of covering further ground without sacrificing fundamentals has always to be borne in mind. The student's receptive ability is governed by his mentality and powers of application. It

does, however, appear important that some of these subjects should, if possible, be introduced into a revised curriculum. Bio-chemistry, for example, in the light of recent advances seems to be a subject upon which veterinary students should receive further instruction. Animal Husbandry, which should include the study of genetics, is also an essential part of their education.

We would prefer some title more appropriate than "Journalism." Our graduates do not necessarily require to have the proficiency of professional writers, but it is very desirable that they may be able to describe clearly and concisely the conditions they are called upon to observe. Many would undoubtedly benefit by training in this respect.

It may be assumed that in selecting a profession the question of future prospects and emoluments must considerably influence one's choice. Anyone entering our ranks will reflect whether it is worth devoting the time and money necessary for a return which in relation to other careers may resemble a pittance.

Unfortunately, this is the position in which the veterinary profession finds itself to-day, and from which it can only be rescued by each in his particular sphere endeavouring to provide convincing testimony of the economic importance of the services he is rendering. Probably no better opportunity of gaining public support in this direction has ever existed than that which at present obtains. For this we have chiefly to thank our research workers and administrators throughout the Empire.

In a paper on Veterinary Education by Colonel G. K. Walker, presented recently at the Annual Congress of the National Veterinary Medical Association, we find, in reference to the curriculum for the diploma of the Royal College of Veterinary Surgeons, the following remarks:—

> "Dissatisfaction with the present course is not heard so much regarding the theoretical knowledge possessed by recently qualified persons as in respect to their technique and their acquaintance with animal management."

Few, probably, will incline to differ from Colonel Walker in this matter. How, therefore, can these defects be rectified? Only by a revision of the methods at present in vogue and a refusal on our part to be harnessed to the forces of reaction.

A veterinary surgeon should be essentially what the term implies. But is the teaching of regional anatomy and the practice and demonstration of surgery on the various species of domesticated animals adequate? Are facilities for teaching practical operative surgery available in all our colleges? Anyone who has visited the great

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continental veterinary schools must have been struck with the amount of attention devoted to dissection and particularly the anatomical study of those regions with which the operative surgeon should be specially familiar.

Then in regard to Animal Management. How can that be taught on a practical scale in veterinary schools situated in cities where the whole atmosphere is foreign to the subject?

Veterinary students require to have free access to livestock kept under ordinary farm conditions. They require to cultivate that knowledge which will enable them to discriminate between what is normal and what is abnormal in animal life. They should be capable of meeting the stock farmer on his own ground to discuss with him matters of common interest, and they will find, thanks to the influence of agricultural college education and popular scientific literature, that many farmers are remarkably well informed. How few young graduates appreciate the importance of possessing a practical knowledge of this subject which later they have to acquire by experience, sometimes at the cost of a humiliating exhibition of their own ignorance.

Even in such simple routine tasks as the collection and preservation of pathological specimens for subsequent laboratory diagnosis, the making of a blood smear, or the furnishing of indispensable data, there is sometimes displayed a want of aptitude inconsistent with the attainments one expects to find among professional men. Does it arise from want of training or from disregard of it?

Our conception of an Empire Veterinary Service should of necessity include the practice of a free interchange of workers. Study leave is essential for those engaged in research, and it is also to be recommended for others who show evidence of special ability. As a reward for good services rendered this privilege would be highly prized. According to where his further studies might be most profitably pursued, the officer selected should be allowed to proceed to any part of the Empire.

To avoid any tendency to occupy the time allotted in a perfunctory manner, work while on study leave should be controlled and a report dealing with it furnished to the responsible director.

Some direct return is expected for the privilege accorded, and it is therefore important to select only those who possess a sense of responsibility and who will take full advantage of the opportunities afforded.

Ministers in charge and heads of departments should support the claims of professional men in these respects. Instead of obstacles regarding salary, subsistence allowance, and passage money being raised, encouragement should be given the promising officer to engage

in post-graduate training; it being borne in mind that the true source of economy is efficiency.

It is also highly desirable to promote and encourage interest in professional work by holding meetings and conferences and providing means of access to current literature.

It happens at times that young graduates are sent to remote districts where they have no opportunity of meeting their colleagues and exchanging views upon subjects of mutual interest. Under these circumstances there is always a danger of the knowledge which they have acquired during their long course of study becoming gradually dissipated. Everything in fact should be done to fan the youthful flames of enthusiasm which, under unfavourable conditions, so quickly die down.

State veterinarians should recognise that their labours are in no sense parochial, and are not confined to the country which, for the time being they happen to serve, but that they can by organised effort assist in no small measure to weld together that veritable League of Nations—the British Empire.

THE TRANSFERENCE OF IMMUNITY FROM EWE TO LAMB.

By T. DALLING, J. H. MASON and W. S. GORDON.

DURING the course of our researches into lamb dysentery we devised a method of protecting lambs from dysentery by the inoculation of the mother sheep with a toxin-antitoxin mixture, prepared from the toxin of an anærobe isolated from lesions in naturally infected lambs. Field results bear out that lambs are protected by such a method; thus in 1926, 2·34 per cent. of lambs born from inoculated ewes died of lamb dysentery, while 18·44 per cent. of lambs from uninoculated ewes died. The figures for 1927 are 0·87 per cent. of lambs from inoculated ewes died, while 8·04 per cent. of lambs from uninoculated ewes developed lamb dysentery.

We have carried out a series of experiments which show that the inoculation of ewes with the above mixture causes the formation of antitoxin in their serum and that lambs born from such sheep have a similar amount of antitoxin.

Method of Testing Serum for the Presence of Antitoxin.

A standard toxin was made by growing the anærobe in meat broth for 12–15 hours, filtering through paper pulp and sand and then through a Berkefeld filter. The filtrate is precipitated with ammonium sulphate, the precipitate is dried *in vacuo* and the residue is finely powdered. A weighed amount of this powdered toxin is

dissolved in saline solution when tests are to be carried out. The toxin in this powdered form has retained its toxic and other qualities for many months. Experiments were carried out to determine the minimum lethal dose of the toxin by the mouse intravenous method, and the minimum skin-reacting dose by the guinea-pig intradermic methods. The smallest amount of toxin causing the deaths of mice and causing skin reactions in guinea-pigs, was used in the testing of the antitoxic content of the sheep sera. Fatal or reacting doses or multiples of them are mixed with 0·2 c.c. of serum, the mixtures allowed to stand at room temperature for about one hour and then injected into mice intravenously or into guinea-pigs intradermically; results are read in the mouse experiments in 24 hours and in the guinea-pig tests 48 hours later.

Testing of Serum from Inoculated Sheep.

Tests of many samples of serum from inoculated sheep have been made. Table I is the result of tests carried out on samples from 10 sheep which were brought to the laboratory for inoculating and testing. These sheep were injected twice during pregnancy, and were bled before injecting after the first inoculation and on several occasions after lambing. No antitoxin could be demonstrated in any sample obtained before injecting, while in three sheep after one injection, 0·2 c.c. serum protected against one fatal dose of toxin. Of the 10 sheep 3 failed to develop any detectable antitoxin after the second injection. Sheep 41 is of interest in that it showed the presence of antitoxin after one but not after two injections. On the day it received its first injection it was necessary to administer 40 c.c. hyperimmune serum. Our test, therefore, detected passive immunity.

TABLE I. ANTITOXIN IN SERUM OF INJECTED SHEEP.

Sheep	Before injection.	After first injection.	After second injection (in days).		
40	Nil	P. 1	7 P. 3	24 P. 3	34 P. 3
41	Nil	P. 1	17 nil	24 nil	44 nil
42	Nil	P 1	17 P. 2	24 P. 1	44 P. 1
43	Nil	Nil	3 P. 2	21 P. 3	32 nil
44	Nil	Nil	14 nil	21 nil	33 nil
45	Nil	Nil	17 P. 3	24 P. 1	44 nil
46	Nil	Nil	14 nil	21 nil	44 nil
47	Nil	Nil	23 P. 2	28 P. 2	54 nil
48	Nil	Nil	25 P. 1	32 nil	50 nil
49	Nil	Nil	16 nil	24 nil	44 nil

Tests done in mice i.v. 0.2 c.c. serum mixed with one or more M.L.Ds. toxin, and stood for about one hour before injecting.

Nil = No protection.

7 P. 3, etc. = protection against 3 M.L.Ds. toxin when test done with serum got seven days after second injection, etc.

Testing of Lamb's Serum for Antitoxin and a Comparison with Antitoxin Content of the Mother Sheep.

Again, many samples of lamb's serum have been tested for antitoxin content. Table II is the result of testing samples of serum from lambs produced by the ewes referred to in Table I. Samples of blood were drawn on the day of the lamb's birth and again when the lamb was 7–9 days old. The results of the test indicate that the antitoxin content of the lamb's serum corresponded closely to that of the mother sheep.

Our experiments do not indicate whether such antitoxin was developed by the fœtus *in utero* or whether it was transmitted to the fœtus *in utero* by the mother or via the colostrum after birth.

Experiments will be carried out during this year's lambing season to establish this point.

TABLE II.—COMPARISON MOTHER EWE AND LAMB SERUM—PRESENCE OF ANTITOXIN.

No ewe and lambs.			Lamb serum (day of birth).		Lamb serum (7.9 days old).		Ewe serum (day of birth of lambs).
41	...	...	Nil	...	—	...	Nil
		—	(*a*)	...	Died i	...	
42	...	—	(*b*) P. 3	...	P. 3	...	P. 2
		—	(*c*) P. 3	...	P. 3	...	
43	...	—	(*a*) Nil	...	——	...	P. 2
		—	(*b*) Nil	...	——	...	
44	...	—	(*a*) Nil	...	——	...	Nil
		—	(*b*) Nil	...	——	...	
45	...	—	(*a*) P. 3	...	——	...	P. 3
		—	(*b*) P. 3	...	P. 3	...	
46	...	—	(*a*) Nil	...	Nil	...	Nil
		—	(*b*) Nil	...	Nil	...	
47	...	—	(*a*) Nil	...	P. 2	...	P. 2
		—	(*b*) Nil	...	P. 2	...	
48	...	—	P. 2	...	P. 2	...	P. 1

Tests done in mice i. v. 0.2 c.c. serum mixed with one or more M.L.Ds. toxin and stood for about one hour before injecting.

Nil = No protection—all mice died.

P. 3, etc. = protected mice against 3 M.L.Ds. toxin, etc.

A POSSIBLE MEANS OF SELECTION FOR NON-DEFORMITY BREEDING IN DEXTER CATTLE.

By WALTER LANDAUER,

Storrs Agricultural Experiment Station, Storrs, Conn.

THE appearance of deformed ("bull-dog") calves still is the most serious problem for the breeder of pure-bred Dexter cattle.

Recent investigations by Crew demonstrated convincingly that this malformation is identical with a human malformation, well known to medical students as achondroplasia or chondrodystrophy. In both the human and the bovine embryo the gross appearance of the skeleton, as well as the intimate changes in cartilage and bone formation are of a very similar nature. A malformation of the same type in chicken embryos was recently studied by the writer. However, in spite of our knowledge of many of the details of expression of this malformation in different animals, no satisfactory evidence so far has come forward to explain the mechanism responsible for the irregular course of development of these embryos. Much attention has been paid to the glands of internal secretion as possible factors in the origin of the monsters. As a result of this work several of these glands (thyroid, thymus, parathyroids) have been ruled out as a probable seat of the causative agencies. There still remains suspicion concerning the pituitary gland, although, in view of our knowledge of the consequences of irregularities in the function of the pituitary, it appears doubtful whether this organ is fundamentally concerned with the appearance of the malformation. Further work must be done in order to determine the physiological source of chondrodystrophy. The solution of this problem may or may not be a tool for avoiding the occurrence of bull-dog calves. Until then, however, the breeders of Dexter cattle must rely on other means to obtain normal stock.

Selection is the only other way open to the breeder in his endeavour to get a herd of non-deformity breeding cows. If it were feasible to select a strain of pure breeding Dexters which do not produce malformed calves, even an effort consuming much labour and time would promise high rewards. At this point, however, a number of questions arise: Is the formation of the bull-dog calves due to inheritance at all? Are these malformations an intrinsic character of the Dexter breed as such, or is there any reason to believe that exhibition Dexter cattle may be bred which bear only normal calves? Is it possible, in other words, to rid the Dexter breed of the evil of producing deformities without altering the typical features of the standard bred animal?

All authors who have concerned themselves with the problem of the transmission of the factors causing the appearance of monstrous calves are agreed upon the conclusion that we are dealing here with an inherited trait (Seligmann, Wilson, Crew, Mohr, Wriedt). With regard to the mode of inheritance, however, diverging views have been developed. Wilson concluded from his own and from Seligmann's material that the production of bull-dog calves is dependant upon one genetic factor only, and that this factor is identical with the one responsible for the short-legged condition of the Dexters. According

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to this interpretation the dominant trait of short-leggedness must be kept in a hybrid state in order to avoid deformities which are the result of a genetically pure condition of this character. Mohr has adopted this view when he says: "In this case (the deformities of the Dexters) we know, then, when a dominant factor with typical recessive lethal action was chosen for a standard character of a breed." According to Crew's work, however, the situation is much more complicated. He assumes one main factor (S), responsible for short-leggedness, and two additional factors (L_1 and L_2) about which he says that they "are modifying amplifying factors and their action is additive. Either alone produces a greater degree of the 'achondroplasia' characterisation, and together they yield the highest grade which is seen in the non-viable 'bull-dog' calf. The 'lethal' constitution is $SS + L_1 + L_2$." Crew, furthermore, suggests that the factors L_1 and L_2 are linked with S. The exhibition type Dexters according to Crew are homozygous for the short-legged condition (S), and for one of the two modifying factors (L_1 or L_2). If animals with different modifying factors are bred together a certain percentage of the offspring will receive the factor S and both modifiers. These combinations result in the appearance of deformed calves. If, then, in a herd all animals carry only L_1 or only L_2 in addition to S, no deformities will occur in this herd. On the basis of this assumption Crew has worked out the necessary steps to eradicate the production of bull-dog calves. This, of course, can be done only by the progeny test.

Any method which would make it possible to recognise directly whether an animal carries one or the other of the modifying factors would greatly facilitate the work of selection, and would save much of the breeder's time and money. If we could tag, so to speak, one of these modifiers, we might eliminate these animals from a breeding herd and retain in it only exhibition type animals which do not carry this factor. The possibility of such a method has been suggested to the writer by recent findings in co-operation with Miss Lorna W. Thigpen. After we had found striking abnormalities in the composition of the blood of chondrodystrophic chicken embryos, we studied the blood of Dexter cattle. An English and an American herd of pure-bred Dexters (the latter to our knowledge the only one in the U.S.) were examined for this purpose. By counts of the white blood cells in blood smears we determined the relative number of the different types of leucocytes and lymphocytes. In both instances we found that one cell type, the so-called eosinophiles, were greatly increased in number in these Dexters as compared with animals of other breeds. These cells have their origin in the marrow of the long bones of the

extremities, the part of the skeleton which in the bull-dog calves is affected to the highest degree. They are easily distinguishable by appropriate staining methods. Very little is known concerning the function of these cells, but we do know that they respond to various abnormal conditions with a relative increase in number, whereas under other influences they become less numerous. Under normal conditions the average of these cells in the blood of adult cattle amounts to about 5 per cent. of all the white blood cells. In the English Dexter herd which we examined, the average of eosinophiles for eight cows was increased to 13·9 per cent., and in the American herd nine cows had an average of 9·69 per cent. of these cells. The bull in the American herd exhibited an equally striking increase in the number of eosinophiles (12·33 per cent.), whereas the two bulls of the English herd appeared to be normal as far as the condition of the blood is concerned. No selection of any kind had taken place in the American herd, whereas the English bulls with a normal blood picture both came from lines selected for non-deformity breeding. Since both these latter animals are show bulls with many awards (one of them was second, the other third at the Royal show), they must carry the factor for short-leggedness (S) and one of the modifying factors (L_1 or L_2) provided Crew's factorial interpretation is correct. Yet the findings in the blood suggest that they must differ from the other animals, and it seems likely that this difference was produced by the selection for non-deformity breeding.

Two explanations of this situation seem possible at present. Accepting Crew's hypothesis of the inheritance of chondrodystrophy in cattle, we might assume that one or the other of the modifying factors affects the constitution of the blood. This explanation seems improbable because in this case all the animals in the American herd would appear to carry this modifier since their blood is abnormal and then should not produce monstrosities. Actually, however, they do produce the monstrous calves. The second explanation involves the assumption that one of the modifiers is recessive with regard to its effect on the skeleton, and is carried in a hybrid condition by all the Dexters unless it was eliminated by selection. Let us assume that this is L_2 in Crew's terminology. Then, all exhibition type animals must be heterozygous for L_1, and in addition may or may not carry L_2. In matings with L_2 coming from both parents and L_1 from at least one of them, bull-dog calves will be produced. In a heterozygous condition, however, the L_2 modifier will cause an increase in eosinophiles, thus revealing its presence.

At present it is impossible to offer a satisfactory explanation both on account of the inadequacy of our knowledge concerning the

inheritance of the deformities and the effect of selection upon the appearance of deformities and upon the constitution of the blood. The fact that bull-dog calves sporadically appear in long-legged breeds (as reported for instance, in a Holstein-Jersey cross by Downs), and cases like one known to the writer in which a Dexter which never had given a bull-dog calf when bred to a Dexter bull produced a deformity the first time when she was crossed to a Shorthorn bull, throw some doubt upon the reliability and completeness of our knowledge concerning the inheritance of the malformation. Since chondrodystrophy in chicken embryos seems to arise from a disturbance of the composition of the egg or of the physiology of the embryo rather than upon a genetic background (Dunn), it might be said, of course, that the sporadic appearance of bull-dog calves in other breeds than the Dexter has a similar origin. In any event, the situation demands further analysis.

Since we know, however, that the production of deformities in general is an inherited trait of the Dexter breed, and since our own observations have established that unselected pure-bred Dexters show a striking deviation from the normal composition of the blood, whereas two show bulls selected for non-deformity breeding had a normal blood count, it appears justified to suspect that these facts have a common physiological cause. Only experience with a larger amount of material can establish the nature of this association and the standards for and possibilities of a practical application in the work of selection. It will be impossible to do this work without the initiative and co-operation of the breeders of Dexter cattle.

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THE TUBO-UTERINE JUNCTION IN VARIOUS ANIMALS.*

By FERDINAND C. LEE

(From the Surgical Hunterian and Anatomical Laboratories of the Johns Hopkins University).

Introduction.

In 1925 two short preliminary notes were published to call attention to the morphology and the possible physiological function of the anatomical structures at the uterine opening of the Fallopian tube. At that time it was noticed that it was sometimes easy to force India ink from the uterus into the tube, while at other times the wall of the uterus would rupture before any injection mass would enter the tube. In a search for an explanation, a routine histological study was made of the region marking the junction of tube and uterus in the ordinary laboratory mammals, and as indicated previously, special structures were found which might help to explain the varying patency of this region. Accordingly, the purpose of this article is to set forth in more detail the anatomy of the uterine ostium of the Fallopian tube in those animals whose organs are commonly studied in the laboratory.

Material and Method.

Unless otherwise specified all the material was obtained from aboratory animals that were killed with ether. The material was fixed as quickly as possible after the uterine injection. In several instances it was felt that a distended uterine cornu, when injected with a fixing fluid, and later fixed in the same fluid, would give a better idea of the anatomical structures, particularly with a view to showing their relationship when subjected to pressure, than would the ordinary non-injected uterus. For instance, it was learned incidentally that the mucosa of the pig's uterus would frequently be in such folds that in such an injected and distended uterus a fold might extend almost completely across the lumen.

Guinea-pig. The material was obtained from a small young female guinea-pig weighing 270 grams. The animal was not pregnant, and it was not until a pressure of 30 mm. of mercury was reached in the injection of the uterine cavity that any ink entered the Fallopian tube. However, even with this pressure only a small amount entered the tube, as was evidenced by traces of this injection mass at the ampulla, as well as by the examination of sections of the Fallopian tube which showed only a small amount of ink within the lumen of this structure (*l*, Fig. 1). The tube joined the uterus almost at the

* We are indebted to the author and also THE JOHNS HOPKINS HOSPITAL for permission to publish this Article.

very apex of the cornu (*b*, Fig. 1). Examination of the uterus showed that its musculature was arranged essentially in the fashion of a closely wound spiral. The entire block of tissue, containing the terminal portion of the cornu of the uterus, with tube and ovary was fixed in Bouin's fluid, sectioned serially in celloidin, and stained with Van Gieson and iron hematoxylin stains.

Microscopic examination showed that the junction of tube and uterus was characterised by a slight elevation within the uterine cavity (Fig. 2). This elevation was not marked by any gross structures, such as polypoid projections as seen in the rabbit and pig, but it was essentially an increase in the stroma layer. The epithelial cells covering this elevation, except for being slightly more columnar,

Fig. 1. × 8. Longitudinal section of a guinea-pig uterus, *a*, to show the coils of the Fallopian tube, *t*, and its entrance into the uterus near the region *b*, which is enlarged in the next figure. In this case the tube enters virtually at the apex of the uterus where a thickening of its wall exists.

resembled the epithelial cells lining the main portion of the uterine cavity. The epithelial cells of the tube were still more columnar. Many of the lumina of the uterine glands within this elevation contained some of the ink which had been injected within the uterine cavity. The stroma cells were packed more densely near the tubal ostium than elsewhere. In this region also, as mentioned above, this stromal layer had the greatest depth, being easily five times as deep as the corresponding layer in the main body of the uterus. Of particular interest was the large amount of plain muscle tissue, chiefly circular in arrangement, which guarded the tubal ostium like a sphincter (*m*, Fig. 2). That this increase in plain muscle is absolute,

and not due to a tangential section of the muscle layer, is obvious from the fact that the section is through the axis of the terminal portion of the tube. A few lymph vessels were seen in the periphery of this muscular layer, and only rarely did these vessels penetrate more deeply into the wall of the uterus.

MOUSE.—The specimen was obtained from an adult female white mouse that was killed with ether. The animal was not pregnant. Bouin's fixing fluid, which was injected into each cornu of the uterus, soon appeared in the ampulla of the tube. It was evident that the

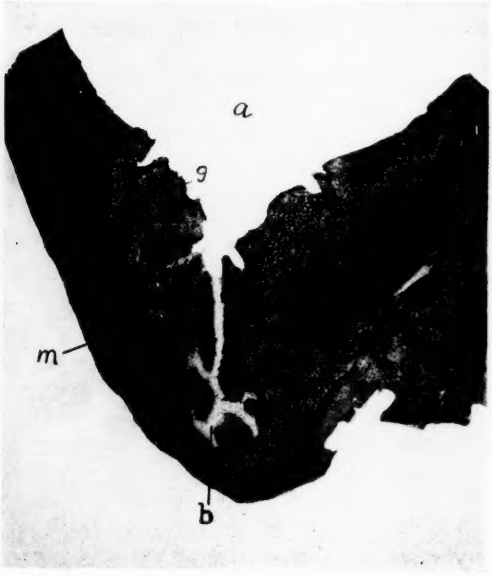

Fig. 2. × 90. Guinea-pig uterus; a magnification of the region *b* in Figure 1. The lumen of the tube, *b*, is in direct communication with the uterine cavity, *a*. The stromal layer is thick here and contains uterine glands, *g*, almost up to the tubal ostium. Although the section is cut longitudinally to the axis of the tube, a marked thickening of the musculature, *m*, is evident, indicating a possible sphincter action.

tube joined the uterus almost at right angles near, but not at, the apex of the cornu. Both cornua were serially sectioned in paraffin at a thickness of six micra, and stained in Mallory's connective-tissue stain. One cornu was sectioned transversely to its axis, the other was cut longitudinally.

Both specimens showed the same general morphological structure. In brief, the entrance of the tube into the uterus was marked by a

very definite mound-like protrusion, as if the end of the tube were partly inverted into the lumen of the uterus (Fig. 3). Through the

Fig. 3. × 80. Cross section of uterus of a white mouse showing the entrance of the tube, *b*, into the uterine cavity, *a*, near the apex of the cornu. In this region the mucous folds guarding the tubal ostium are markedly developed, and one, *c*, is situated quite laterially. Any distention of the uterine cavity might easily compress these folds over the tubal opening and effectively block this passage.

Fig. 4. × 8·3. Section of uterus, tube and ovary of rat. The uterine cavity is represented by *a*, the tube with its many convolutions by *t*, and the ovary by *o*. The area *b*, marking the entrance of the tube into the uterus, is enlarged in Figure 5.

centre of this projection the tube entered. The epithelium at the tubal ostium resembled more that of the tube than that of the uterine

cavity. No glands were seen in this protruding structure in which the stroma cell layer was increased in thickness, but less compact than elsewhere. A slight increase in the circular muscle at the tubal ostium, as well as a blood supply better than in the adjoining tube or uterus, was noted. It was difficult to determine with any degree of certainty the amount of lymph supply to this region; however, it was insignificant in comparison with the large supply found in the rabbit and pig.

RAT.—An adult female rat, that was not pregnant nor in œstrus was injected with India ink into the right uterine cornu. The intra-

Fig. 5. × 120. Tubo-uterine junction of rat; an enlargement of *b*, Figure 4. Again, a mound-like elevation marks the entrance of the tube, *b*, with the uterine cornu, *a*. The increased circular plain muscle, *m*, suggests a sphincter action. Apparently the ink, particles of which, *i*, are in the uterus, never entered the tube.

uterine pressure was controlled with a mercury manometer, and even when the pressure reached 250 mm. of mercury no ink entered the tube. While this pressure was being maintained, the uterus was ligated and placed in Bouin's fixing fluid. The specimen was subsequently serially sectioned in celloidin and stained with iron hematoxylin and Van Gieson stains.

As will be seen from Figure 4, the tube joined the uterus in a manner similar to that found in the white mouse, that is to say, the juncture was not at the very apex of the cornu, but slightly below this point. A definite elevation in the uterine cavity, conical in character and again similar to the one found in the white mouse, was present at this ostium. The epithelium lining this elevation was slightly different from that found in the neighbouring uterine cavity and tube, in that the individual cells were cuboidal and contained only a little cytoplasm. Particles of India ink were present at the very ostium of the tubal orifice (Fig. 5), but none of this injection mass had entered the tube. The stroma layer was again relatively thick, and the individual

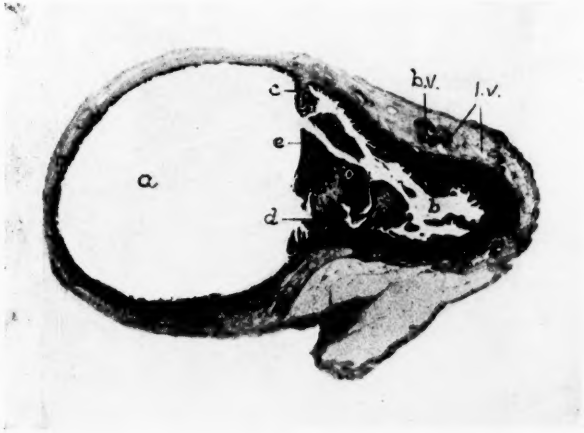

Fig. 6. × 7·7. Section of the pregnant uterus of a rabbit. At the junction of the tube, *b*, with the uterine lumen, *a*, several projecting folds, *c* and *d*, are seen which partially block the tubal ostium. A bit of fetal membrane is at *e*. Blood vessels, *b.v.*, and lymph vessels, *l.v.*, are recognisable. The marked thickness of the muscle layer at *d* is given in greater magnification in Figure 7.

stroma cells were less compact than those in adjoining areas of the uterus. One of the striking features was the large amount of circular muscle at the tubal ostium (*m*, Fig. 5). The blood supply to this general region was good, but not unusually so. Only a few small vessels, apparently lymphatic in character, were seen.

RABBIT.—In the rabbit one could detect with the unaided eye the presence of numerous polyp-like masses within the cavity of the uterus at the tubal ostium. With a hand lens from twelve to eighteen of these projections were readily counted; they formed a compact mass, which occupied completely the opening of the tube. After the uterus was opened longitudinally at this point the individual polypoid

masses had two or more smaller protrusions on them. The average length of these large projections was about 1·2 mm. In this animal also the tube joined the cornu of the uterus obliquely (Figs. 6 and 8). In the specimen shown in Figure 8, ink did not pass into the tube until a pressure of 60 mm. of mercury had been reached.

Microscopically, the polypoid projections were covered with ciliated columnar epithelium which was virtually identical with the epithelial lining of the tube ; the uterine epithelium was relatively more cuboidal.

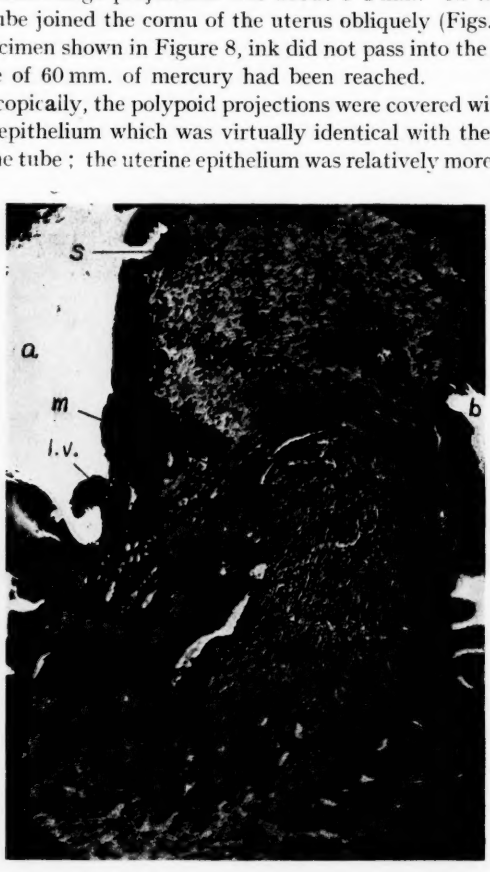

Fig. 7. × 90. Rabbit uterus ; enlargement of area *d* in Figure 6. The base of a mucous fold is represented as situated between the uterine cornu, *a*, and the tube, *b*. The stromal layer is indicated by *s*. At the base of this layer is a well defined circular layer of plain muscle, *m*, having numerous lymph vessels, *l.v.*

Only a few glands were seen, and these were at the base of the most lateral projections. The bulk of each protrusion was made up of loose connective tissue which contained an average number of blood and lymph vessels. The plain muscle layers, chiefly the circular, were definitely increased at the tubal ostium (Figs. 7 and 8). In this respect a specimen obtained from a pregnant uterus was of particular interest ; for in this case, as is shown by Figure 6, some of the polypoid

masses were made to project well into the lumen of the tube. One of these masses was particularly large, and its base rested on a marked elevation of circular muscle (Fig. 7). Examination of serial sections of this region showed that this marked increase in circular muscle was not always capped by a polypoid projection, but was well within the uterine cavity for a portion of its extent. A peculiar feature of this specimen was that this bit of circular muscle was markedly developed only for about a half of the tubo-uterine juncture. In Figure 8, taken from a non-pregnant uterus, the circular arrangement is well represented on both sides of the tubal lumen. Again the blood supply to this part of the tube and uterus was unusually abundant. Lymph vessels were present in great numbers within the polypoid masses, plain muscle and adventitia.

Fig. 8. × 40. Uterus of a rabbit. The animal was not pregnant. The tube, *b*, enters the uterus, *a*, obliquely. At this junction there are numerous polyp-like projections, *c*, some of which are continuous with the longitudinal folds within the tube. The circular muscle is prominent at *m* and *m'*.

CAT.—At the end of a sacrifice experiment on an adult non-pregnant cat, India ink was injected into the right cornu of the uterus in the direction of the tube. Since no ink escaped into the abdominal cavity even though considerable pressure was exerted upon the syringe, it was decided to investigate the reason why no ink entered the tube. The tubo-uterine juncture, which showed that the tube joined the uterus obliquely, was fixed in Bouin's solution and sectioned serially in celloidin. This animal gave the first clue as to the mechanism which prevented the injection of the lumen of the tube.

Examination of the sections showed that there was a definite elevation within the uterine cavity at the point where the tube entered (Fig. 9). Through the centre of this elevation the lumen of the tube continued, and opened in an irregular fashion near the apex of this more or less regular protrusion. The mound-like mass, *d*, in this figure was shown by a study of the serial sections to be an elaborate extension of one part of the elevation. The epithelium lining this elevation was a transition form between the relatively flat cells of the uterine mucosa and the more columnar cells lining the tube. Uterine glands were seen mainly at the peripheral portion near the base ;

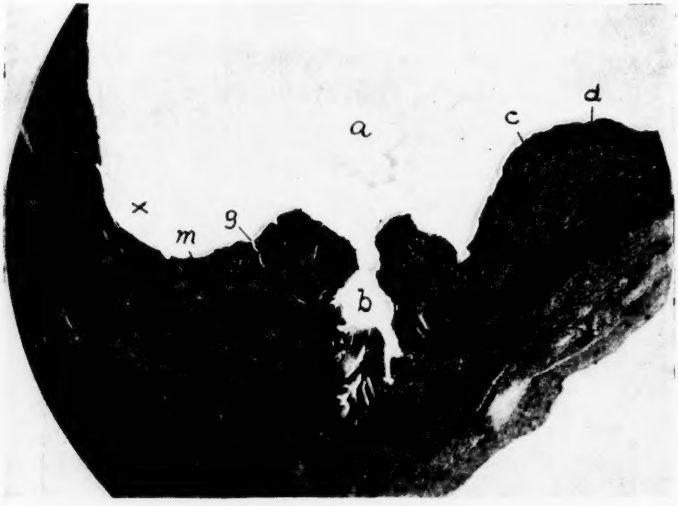

Fig. 9. × 50. Uterus of a cat. The tube, *b*, joins the cornu, *a*, obliquely near the apex, *x*. At this junction are several folds, some of which have glands, *g*, near the ostium, whereas others, *c*, have the uterine glands limited as at *d*. The circular muscular layer at *m* is well developed.

a few structures resembling large uterine glands, *g*, were observed only on one side of the elevation. The stroma layer was relatively dense in this elevation, and contained a large amount of fibrous connective tissue. The plain muscle, particularly the circular band of fibres, was well developed, and again suggested a sphincter activity. A good blood supply to this general region was noted ; lymph vessels were few and small.

A wax-plate reconstruction was made of this specimen, but since

Figure 9 shows the essential features of this specimen no further illustrations were deemed necessary.[2]

Dog.—The specimen was obtained from an adult non-pregnant female dog whose uterus was large and firm, suggesting an early pre-

Fig. 10. × 4·1. Section of the uterus of a dog to show the oblique entrance of the tube, *b*, near the apex of the uterine cornu, *a*. The two folds, *c*, at this point are enlarged in Figure 11.

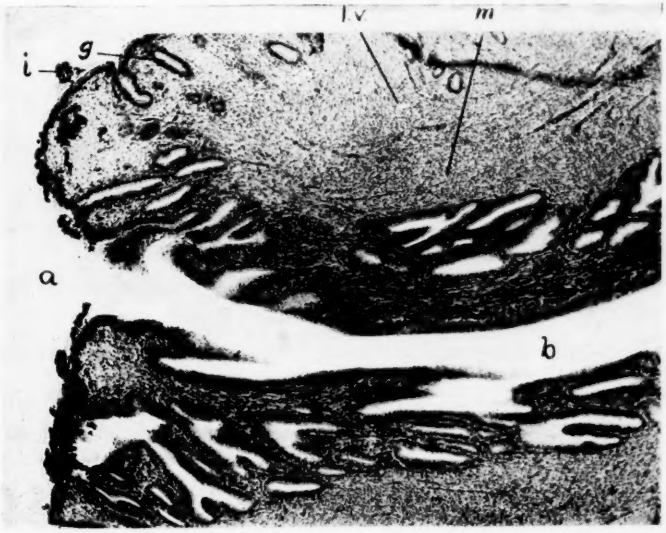

Fig. 11. × 70. Enlarged photograph of the tubo-uterine junction of the dog as given in Figure 10. The tube, *b*, enters the uterus at *a*. Uterine glands, *g*, are near this point. The plain muscle layer, *m*, is increased and is supplied by a moderate number of lymph vessels, *l.v.* Although ink was injected into the uterine cavity under pressure, some ink particles, *i*, are seen on the uterine epithelium, but none have entered the tube.

[2] This wax plate reconstruction, as well as the taking of the photograph for Figure 14, was made possible through the co-operation of Dr. George L. Streeter, of the Department of Embryology, Carnegie Institution, Washington, D. C.

menstrual state. India ink was injected into one of the cornua, and although considerable pressure was used, no ink escaped through the tube. As shown in Figure 11, particles of ink are present at the very tubal ostium, but none are found in the lumen of the tube, thus indicating that the lumen was closed. The tube joined the uterus obliquely and not at the very apex of the cornu (Fig. 10). This juncture, together with the ovary and tube, was fixed in Bouin's solution.

It was seen (Fig. 10), that there were numerous large folds and mucous projections at the apex of the cornu, and the protrusion which marked the entrance of the tube was not more conspicuous than the others. The ciliated epithelium at the tubal ostium was highly columnar and resembled more the epithelium of the tube than the

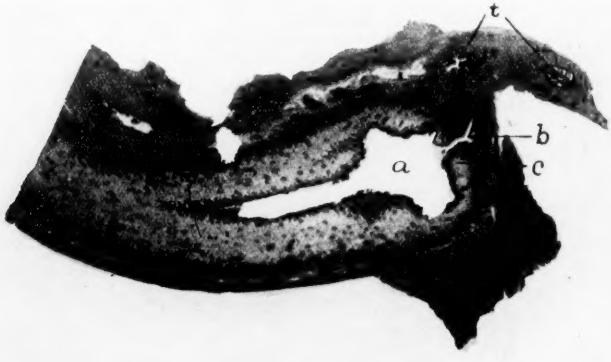

Fig. 12. × 5. Section of the uterus of a young lioness. The tube, *t*, with its numerous convolutions joins the uterus, *a*, obliquely. A slight mucous fold is at *c*. The area *b* is enlarged in Figure 13.

slightly less columnar epithelium of the uterine cavity. Uterine glands were present almost to the very opening of the tube. The stroma cells were very loosely arranged at the extremity of the mucous projections; however, they were more densely packed at the base where fibrous connective tissue was also more in evidence. Plain muscle tissue, particularly in the circular layer, was well developed (Fig. 11) and appeared to sweep down with the corresponding layer of the tube. The usual good blood supply was present in this region; but the lymph vessels were small and few.

Lion.—It is obviously difficult to include the lion in the group of laboratory animals. However, it happened that a female lion cub which was born and raised in the local zoological park, after having

reached the age of one and a half years, developed a deformity of the legs, not unlike rickets, which made the animal unfit for exhibition purposes. About two hours after the animal had been killed with potassium cyanide it was possible to obtain the reproductive organs. India ink was injected into the left cornu of the uterus, and although great pressure was exerted upon the syringe, no ink escaped from the tube; subsequent histological examination failed to show any ink within the lumen of the tube (Fig. 13). With the uterine cavity still under pressure the tubal end of the uterus was fixed in formalin and sectioned serially in celloidin.

Fig. 13. × 100. Uterus of a lioness; a magnification of area *b* in Figure 12. Uterine glands, *g*, are at the very junction or tube, *b*, and uterus, *a*. The circular layer of plain muscle, *m*, is increased. Some of the injected ink, *i*, entered the tube. A few large lymph vessels, *l.v.*, were observed.

The histological sections showed that the tube joined the uterus obliquely (Figs. 12 and 13). There was only a slight elevation within the uterine cavity at the tubal ostium. Again the ciliated epithelium covering this region was slightly more columnar than that elsewhere in the uterine cavity, and in general resembled the tubal epithelium. Uterine glands were present almost to the very opening of the tube. Stroma cells were relatively few near the epithelial layer, but were more compact and were joined by fibrous connective tissue at the muscle layer. Again the circular layer of plain muscle predominated at the tubo-uterine junction (Fig. 13). The blood supply to this

region was very good. Lymph vessels were not numerous. The muscular layers and adventitia had large vessels (Fig. 13), whereas the stroma layer had only a limited lymph supply.

PIG.—All the specimens of the sow's uterus were obtained in a fresh condition from a neighbouring slaughter-house. With the unaided eye large polyp-like projections were seen guarding the tubal ostium and projecting into the uterine cavity. If the uterine cornu was injected with fixing fluid under pressure, then these projections appeared more flattened. An idea of these masses can be gained from Figure 14, which was made from a specimen macerated in 30 per cent.

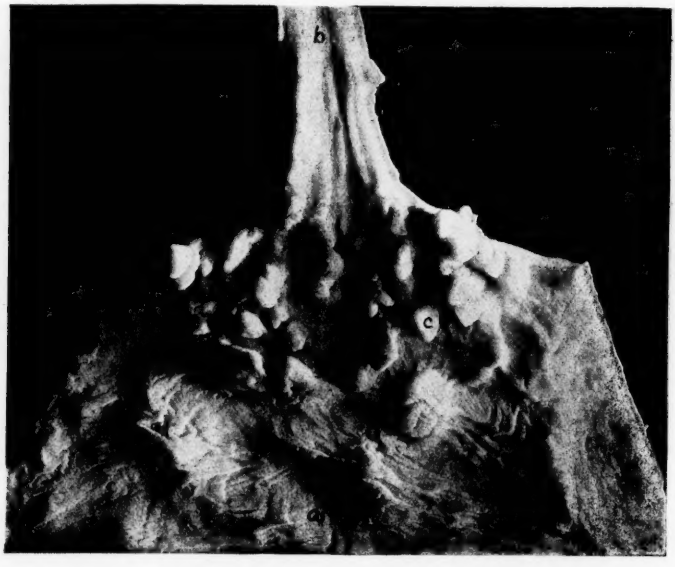

Fig. 14. × 4·6. Photograph of a dissection of the mucous coat at the tubo-uterine junction in the pig. At the junction of the tube, *b*, and the uterus, *a*, are seen numerous polyp-like projections, some of which, *c*, are sharply outlined, whereas others, *d*, are more flat and blend more readily with the uterine mucosa.

alcohol for 24 hours; the mucosa was then dissected off from the underlying muscular coat and the specimen pinned out on cork and fixed in formalin. It will be seen that the polypoid masses are distributed irregularly at the tubal ostium, and although about 37 individual bulbous masses can be counted, several of them frequently are on one stem. In general it will be noted that they are more numerous near the opening of the tube, and gradually become less peripherally in the uterine cavity. As a rule, the longitudinal folds within the tube terminated in one or more of these projections which

were usually not pedunculated. The polyps were frequently 2 mm. high.

The material for Figure 15 was taken from an adult sow whose right uterine cornu was injected with India ink, and it was not until a pressure of 100 mm. of mercury was reached that any ink entered the tube. This figure illustrates very well the oblique angle at which the tube joins the uterus. The epithelium covering these polyp-like masses was slightly more columnar and also contained more cytoplasm than the epithelium elsewhere in the uterus; it resembled more the epithelium of the tube. Uterine glands were quite common in

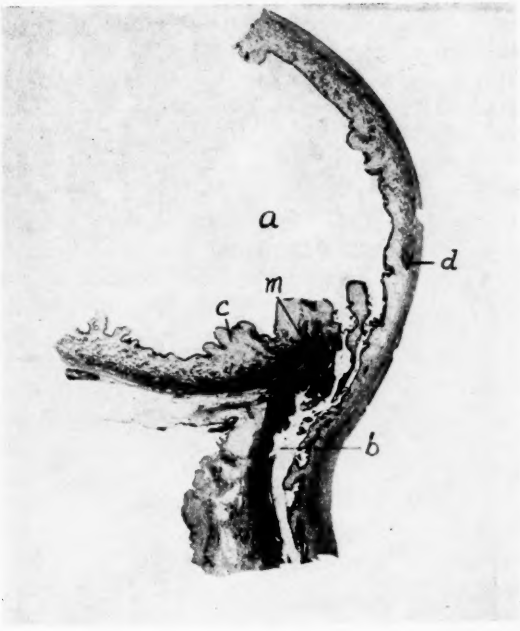

Fig. 15. × 5·5. Section of a pig's uterus, to show the oblique manner in which the tube, *b*, joins the uterus, *a*. Polyp-like projections, *c*, guard this communication. The circular muscle layer at *m* is well developed. Uterine glands do not extend beyond the point, *d*. In several instances, apparently due to the efficient closure of the tubal ostium by these polypous masses, the uterine wall was ruptured before any material injected into the uterine cavity escaped into the tube.

this general region and sections of such glands were frequently seen at the base of the polyps. The stroma layer was very loosely knit in the body of the polyp-like projections but became more compact at the base. The circular muscle layer was only slightly increased at the tubo-uterine junction, and the bulk of this increase was on the side of the tube which made the acute angle with the uterus. In fact, the musculature at this point was only slightly greater than that in the

adjoining part of the tube. There was the usual good blood supply in this region. Of particular interest was the large amount of space occupied by the lymph system. Not only were the polypoid masses frequently almost completely filled by a lymph sinus (Fig. 16), but the entire stromal layer as well as the muscular coats and adventitia had large vessels. It is difficult to think of any tissue which shows a prettier lymphatic picture than that offered by this region.

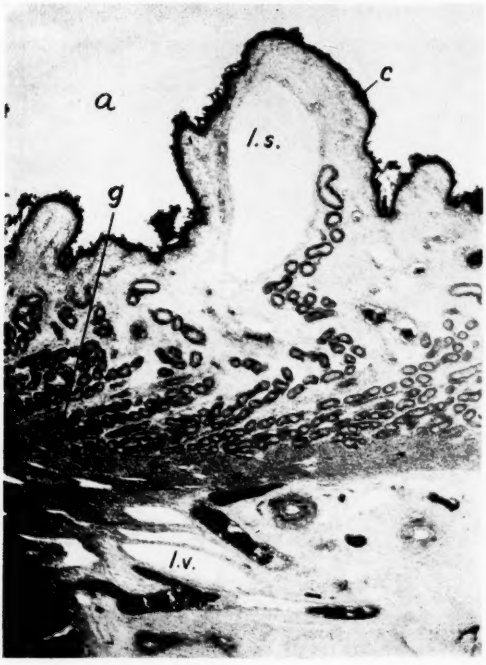

Fig. 16. × 38. Section of a pig's uterus near the tubal ostium to show the nature of the large lymph sinuses, *l.s.*, which frequently occupy a large part of a polypous projection, *c*. The axis of the uterine glands, *g*, is more oblique as the tube is reached. The uterine lumen is given as *a*. Numerous lymph vessels, *l.v.*, are in the muscular coat and adventitia.

Literature and Discussion.

Anatomically, not very much has been written on the tubo-uterine junction in lower animals. Bischoff in 1852 described very well the gradual transition of tube and uterus in the guinea-pig; but he did not note any mucous folds at this point. Allen, in 1922, mentioned valve-like folds which guarded the entrances of the oviduct into the uterine cornu of the mouse. The most recent account was that by Kelly, in

1927, who reconstructed the uretero-tubal junction in the guinea-pig and showed that numerous folds of mucosa guard the tubal ostium.

It is of course impossible to make generalisations on the morphology of the tubo-uterine junction from the material detailed above. However, except in the rat and guinea-pig, the tube joined the uterus at an angle near the apex of the cornu. This relationship was particularly obvious in the case of the pig and rabbit. For the guinea-pig Kelly stated that the uterine horn was a trumpet-like expansion of the tube which did not enter its wall obliquely. Taken by and large it seemed as if the tube were partly invaginated into the uterine cavity, and in favour of this view may be mentioned that the epithelium resembled more that of the tube, and that the muscular coats of the tube swept into the uterus for a short distance, e.g. Figure 15, before they were joined by the corresponding coats of the uterine wall. Again, uterine glands were absent at the junction in many of the animals thus stressing a tubal characteristic.

The character of the mucous folds or polyp-like masses was not constant. There was a great difference, not only in size, between the large polypoid projections of the pig and rabbit and the relatively small folds in the rat and dog, but also in the number of these folds. As a rule, the folds were more developed on that side of the ostium which was nearer the apex of the cornu.

One feature was virtually constant for all animals, namely, the increase in the size of the sphincter muscle at the tubal ostium. In the mouse this musculature was scant. Possibly certain physiological changes in the uterus, such as pregnancy, caused an increase in this as well as the remaining muscular layer. Such a condition might explain the interesting ridge of musculature in the pregnant rabbit (Fig. 7) particularly so since the non-pregnant uterus of the same species did not show such a marked muscular development (Fig. 8).

The large lymph sinuses within the polypoid projections, particularly in the pig, were very unusual. The general morphology of these lymphatic vessels has recently been described by Andersen for the pig. Large lymph vessels were seen not only in the mucous folds, but also in the plain musculature and adventitia. The smaller the animal the fewer were the lymphatics ; the lioness was an exception.

Physiologically, the tubo-uterine junction has received considerable study and speculation. Many investigators have found it difficult at times to inject the tubes from the uterus, but only a few have studied the anatomy of the region in order to find out a possible reason for the difficulty. Allen noticed that it was difficult to inject the oviducts from the uterus in the mouse, but he found that valve-like folds of the mucosa guarded the entrance of the oviduct into the uterine cornu, and thus there was an anatomical basis for the difficulty

with the injection. He stated that the valves guarded against a back-flow of material into the tubes from a distended uterus. Examination of Figure 3 will readily explain why the mound-like folds will collapse and block the passage of material into the uterus, irrespective of the presence of a plain muscle sphincter in this region which need only play a minor part in the occlusion.

Other investigators, v. Mikulicz-Radecki, Lueg, and Nahmmacher, believed that a mechanism was present that prevented the transport of fluid from the uterine cornu into the tube of the rabbit. This mechanism they believed to be due to the ordinary pressure exerted by the normal peristaltic force of the tube in a direction which was towards the uterus. Not until this force was overcome by the pressure of the injection was any contrast fluid which was opaque to the roentgen ray forced into the tube. These authors made no histological study of the tubo-uterine junction and therefore were unable to consider the polypoid projections which surrounded the tubal ostium at this point (Figs. 6, 7 and 8). Undoubtedly the efficiency of the closure of the tube at this point was attested to by the fact that these authors did not find within the tube or peritoneal cavity any of their injection mass which had been coloured with indigo-carmine and which had been allowed to remain in the uterus four hours under low pressure.

Also in 1926, Bondi, after studying the tube and uterus in the rabbit, advanced a different explanation for the fact that, when he tied off the uterine cornu, material from the resulting cystic extremity of the uterus did not enter the tube. He believed that the occlusion of the tube under such circumstances was due to its anatomical arrangement since it entered the uterine cornu obliquely and thus reminded one of the entrance of the ureter into the bladder. Accordingly, the greater the distension in the uterus, the greater would be the lateral pressure on the tube as it pierced the uterine wall. He studied the morphology of this region microscopically, and it is interesting to note that the large polyp-like folds at the tubal ostium apparently were of no significance in comparison with the course of the tube through the wall of the uterus.

That a sphincter might be responsible for the occlusion of the tube was considered by Schneider and Eisler in 1927. These authors injected iodipin into the uteri of women, and by means of the roentgen ray found in numerous instances a definite sphincter-like constriction at the uterine ostium of the tube. They believed that the sphincter-like contraction which they observed was due to the contraction of the well developed circular layer of plain muscle, and that the fluctuation in transuterine insufflation pressures as noticed by Guthmann were

probably as much due to the contraction of this sphincter as to the peristalsis of the tube.

Rubin has recently stated that he was able to detect a spasm at the tubo-uterine junction in his peruterine insufflation tests for tubal patency. He recorded the pressure fluctuations on a smoked drum, and noticed that in such a case the initial pressure rose well above 100 mm. of mercury, usually from 150 to 180, even reached 200 mm., and then fell to 140 or less gradually, or it fell more sharply to a lower level when more or less typical fluctuations were evident. Whatever evidence Rubin had to substantiate the claim that such a curve was due to a spasm at the tubo-uterine junction only was not presented.

In connection with the Rubin test it will be recalled that Ferguson has reported a marked discrepancy in the pressures necessary for the insufflation in the same individual at different times. Whether this difference was due to the ordinary premenstrual swelling which might partially block the tubal ostium or whether it was due to a spasm of the sphincter at the tubo-uterine junction, or to both factors, was not discussed.

From a study of the musculature at the tubo-uterine junction in the laboratory animals as reported above, it seems reasonable to suppose that a sphincter action might be partly if not entirely responsible for an obstruction of the tube. In many animals this circular muscle layer was well developed, and together with such marked polyp-like projections as were observed, for example, in the pig and rabbit, the contraction of this muscle might approximate these projections and block the tubal opening very effectively. In this respect the polypoid masses might function in a manner similar to the Pförtnerschwulst of the pyloric portion of the pig's stomach in being an accessory sphincter structure, and be of particular use in pregnancy. In the case of the rabbit some of these masses were forced into the lumen of the tube (Fig. 6).

That this sphincter mechanism was effective was easily attested to by those experiments in the pig in which the wall of the uterus ruptured before any material was forced into the tube. Kelly ruptured the uterine horn in the guinea-pig on several occasions without injecting any material into the lumen of the tubes. In one instance he recorded a pressure of 504 mm. of mercury without any injection of the tube. That the uterine wall of the guinea-pig withstood such a pressure is equally remarkable.

In certain injections of the pig's uterus it was noticed that the tube on one side could be injected with relatively little pressure, whereas a corresponding injection on the opposite side was obtained only with much higher pressure.

Whether there is any relationship between the patency of the

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uterine ostium of the tube and the various stages in the œstrous cycle has apparently not been definitely determined as yet. Dyroff has considered a relationship between an internal secretion of the corpus luteum and a dilation sensitivity of uterus and tube as mediated by the involuntary nervous system. The patency of the tubal ostium in the pig may thus be determined not only by the tone of the muscular sphincter, but also by the size of the polypoid projections which may vary with the lymphatic engorgement.

As regards the human uterus, Kennedy in 1925 indicated the rôle which a spasm of the isthmic portion of the tube may cause. For example, a spasm of the tubo-uterine junction may be responsible for the pains associated with dysmenorrhea. Again, delayed conception or even sterility might be produced by the occlusion of the tube at its uterine ostium. Finally, it is possible that the entrance of the fertilised ovum into the uterine cavity might be blocked by a sphincter action at the tubo-uterine junction, and a tubal pregnancy be produced. Certain it is that the lumen of the tube at the uterine ostium is very small, and that the sphincter muscles here are well developed (Williams).

Summary.

A brief account has been given of the general morphology of the tubo-uterine junction in various animals. In the rabbit and pig there were numerous polyp-like projections visible to the unaided eye extending into the uterine cavity. Similar folds, but less in degree, were found in the mouse, rat, guinea-pig, and cat; in the dog and lioness they were developed the least. In all animals the circular layer of plain muscle fibres in this region was well developed and suggested a sphincter action, which, together with the mucous folds, might effectively shut off the tube. In fact, in several instances the uterine wall was ruptured before any injection mass escaped into the tube. The relationship of this mechanism to such physiological states as the œstrous cycle and pregnancy, and to such pathological conditions as dysmenorrhea, sterility and ectopic pregnancy is considered briefly.

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Clinical Articles

"Lucerne Disease."

(Aphis Disease, Leaf Louse Disease.)

By MAJOR H. ALLEN, R.A.V.C.,
Remount Depot, Mona, Punjab, India.

SEVERAL writers have recorded the occurrences, amongst imported cattle in hot countries, of a peculiar dermatitis which affects the unpigmented parts of the skin and is induced after the ingestion of quantities of certain foodstuffs, such as green clover, lucerne, trefoil or buckwheat.

The white parts of the skin become covered with irritating sores, which are sharply limited to these parts, and do not extend to the coloured portions.

The writer had similar cases in his segregation paddocks at Mona Remount Depot during 1927, amongst the young stock horses, fed on lucerne heavily infested with Aphis in large quantities. The white parts of the head and limbs only were affected.

The inflammation of the parts, however, very soon disappeared, and this was followed by prolonged disquamation.

It is interesting to consider the possibility that a photo-sensitive substance absorbed with the foodstuffs is excreted through the skin and, under the action of the strong direct rays of the sun, is converted into something which produces the irritating effects upon the white patches.

Hutyra and Marek, vol. iii, 1926, p. 633.

"Traumatic Salivary Cyst, with Calcareous Deposits on Outer Wall, Occluding Stenson's Duct."

By MAJOR H. ALLEN, R.A.V.C.,
Remount Depot, Mona, Punjab, India.

SUBJECT.—Chestnut country-bred gelding aged four years, seven and a half months.

HISTORY.—Was admitted for Bastard Strangles involving the face area on April 4th, 1925, and was discharged convalescent on May 4th, 1925.

Blockage of Stenson's duct in the shape of a soft movable painless swelling about the size and shape of a guinea-fowl's egg, was noticed on October 17th, 1927, lying over the posterior edge of the left ramus, associated with distension of the duct behind the swelling and damming of the saliva.

The cause was due to injury of the mucous membrane of the duct, the result of incising a strangles abscess in the neighbourhood of the duct, and thereby causing a salivary fistula.

On October 10th, 1928, the swelling appeared as a hard painless, sharply defined, movable enlargement, about the size and shape of a Turkey's egg lying along the posterior border of the left inferior maxilla.

The duct was markedly distended behind the cyst.

TREATMENT.—Consisted in operative removal by means of a longtitudinal incision along the lower surface of the enlargement. The wound was carefully closed by interrupted sutures and strict antiseptic precautions were observed during and after the operation on October 21st, 1928.

Calcareous Salivary Cyst.

The patient was discharged as cured on November 12th, 1928. A slight thickening remains of Stenson's duct extending around the posterior edge of the digastricus and inferior left maxilla, to the antero-inferior surface of the parotid gland, within three inches of the base of left ear.

DESCRIPTION OF ENCYSTED CYST.—On removal the cyst was found to be encased thickly with fibrous tissue.

It was about the size and shape of a turkey's egg.

Weight.—4 ounces and 3 drachms.

Measurements.—Length, 7 cms.; breadth, 4·8 cms.

On removal of the actual cyst by boiling process, all that remained

was a calcareous shell, about the size and shape of a hen's egg, rough, hard and whitish in colour.

Weight.—2 drachms and 22 grains.

Measurements.—Length, 5·53 cms.; breadth, 3·52 cms.

The contents of the cyst consisted of a thick brownish mucoid material.

The posterior end had a pedicle about half an inch long, binding it down to the lumen of Stenson's duct, thereby causing blockage of the duct and damming of saliva.

Note.—Stenson's duct (Ductus parotideus Stenonis) commences at the antero-inferior surface of the parotid gland, near the insertion of the Sterno-maxillaris, passes along the posterior aspect of the digastricus round the inferior jaw, with the submaxillary artery and vein lying most posterior and along the anterior border of the masseter and entering the mouth obliquely opposite the third upper cheek molar.

The canal consists of an internal mucous and an external contractile coat.

A Case Suggestive of Grass Disease, in Essex.

By RALPH BENNETT, F.R.C.V.S.,

Romford.

SUBJECT.—A very nice bay shire gelding in good condition.

FIRST VISIT (MAY 31ST).—Horse sweating very much, indeed, yet apparently not in much acute pain. Temperature normal; pulse 52-55. Auscultation of chest revealed nothing. Patient rather excited and tried to get out of loose box.

HISTORY.—The horse had been turned out and had also had some rather heated lawn grass. The symptoms of illness appeared quite suddenly. The owner—a very good horseman and very observant—suspected pneumonia and had rugged the horse heavily. He also stated that the horse had had slight regurgitation of food down the nostrils.

TENTATIVE DIAGNOSIS.—Some derangement of the digestive system, but no evidence of real colic, or of twist or rupture. I queried the cause of the excessive sweating. Was it due to excitement from being shut up alone; or (as the day was very hot) from being heavily rugged; or, possibly, to congestion of the laminæ of feet?

TREATMENT.—Six drms. of aloes as a ball. Had shoes removed and feet poulticed. Soft food.

SECOND VISIT.—Horse much better. No sweating, but considerable muscular tremors, particularly of shoulder muscles. Physic acting well.

THIRD VISIT.—Improvement, but muscular tremors more marked.

The horse has some difficulty in feeding; he gets a mouthful of food, but apparently cannot swallow it easily until he takes some water into his mouth as well. Getting very tucked up in the flank.

Prescribed liquor strych. 1 drachm, liquor ferri perchlor. 1 drachm, water 1 ounce, twice a day.

On thinking over the case, began to suspect possibility of grass disease.

FOURTH VISIT.—Horse not quite so well. He is a little uneasy, frequently appearing as though he wishes to urinate. Not much appetite, and still some difficulty in swallowing. He makes the food in the manger very wet by slopping water over it. The horse looks lively, walks well and strongly, but is *very* "tucked up" and begins to take on the "herring" appearance in flanks. Muscular tremors still marked.

FIFTH VISIT.—Brighter, and eating a little better. Gave 10c.c. Nuclein and also 15 grammes of Istizin (Bayer) as a ball, and blistered throat.

SIXTH VISIT.—Appetite slightly improved. Tremors still noticeable. Temperature 100° F.; pulse 52. The Istizin acted freely.

SEVENTH VISIT.—Quivering of muscles much decreased. Purging ceased and fæces quite normal. Mucous membrane of eye very yellow, as it had been throughout the illness.

EIGHTH VISIT.—Five days later. The horse was found down and unable to rise. After the last visit he had appeared to be rallying well, but suddenly ceased to feed on June 17th, and was found down on the 18th. Destroyed as hopeless.

POST-MORTEM.—Stomach and bowels (large and small) all inflamed. Apparently a very sub-acute inflammation which probably accounted for persistent lack of appetite. The stomach contained a quantity of bots.

Lungs.—Early stage of broncho-pneumonia. Left lung had a small patch of red hepatisation.

Tongue.—The dorsum was quite black, but there was no accumulation of food in fauces and no sign of inflammation around throat.

Other organs all appeared normal.

REMARKS.—This was to me a very unusual case, and although it presents many features in common with grass disease, I am not satisfied that it really was that disease. It does appear though, that it was due to the absorption of some toxin from the digestive tract. The farm is a very good one; food and hygiene very good; well above the average. The only doubtful food being the lawn grass which the horse, in common with others, got by accident. No other horses were affected in any way.

XUM

In view of the unusual nature of the case, I have thought it best to report it just as jotted down in my case-book day by day: with observations as they occurred to me.

Temperature remained normal throughout, and the pulse never exceeded 55 to the minute.

Sheep Dipping Fatalities.

By H. C. ROCKETT, M.R.C.V.S.,
Salisbury.

On a farm near here there was an outbreak of sheep scab, and the sheep were dipped in the usual way with a proprietary dip (I am not sure which) and they did quite well. However, the owner was advised by his friends that there was no dip like "So-and-so's" (I do not mention names for obvious reasons), and there was no man who could dip sheep like he could.

So the owner decided to dip again, and I am told that each sheep was kept in the dip for two minutes. At the time of dipping one or two sheep became unsteady in their gait, but the man who did the dipping said that they would recover quite soon.

The shepherd who helped with the job complained that his arms and face were badly blistered and swollen for a day or two after.

About a fortnight or a little more later I was called in to see the sheep as several were very unsteady and a couple were down and almost comatose with the head twisted round to the side.

I slaughtered these and made a careful *post-mortem*, but could find nothing to account for the condition, so removed the heads and took them home for further examination and stated that the trouble was probably due to worm cysts, but on opening the skull could find none.

I did find in one case that the ear on one side was badly infected with maggots, but in the other sheep this was not so, so I looked further and removed the brain carefully and then in each case found between the bone and the dura an appreciable amount of pus which could be traced through to the ear, hence, no doubt, the maggots in one case. I have never seen a similar case and think that the dip used must have been pretty strong and contained some caustic which gradually penetrated through to the brain.

This may be quite wrong, but I do not know how else to account for the condition. There was no general infection of the brain. About a dozen sheep were affected in all, but the others were slaughtered as soon as they showed symptoms, but the butcher who killed them told me that he had opened the skulls of a couple and found the same condition.

XUM

Ruptured Diaphragm.

Cairn Terrier, 15 Months Old.

By BERNARD GORTON, M.R.C.V.S., M.P.S.,
Bournemouth.

THE dog was run over by a motor car on August 21st, and on examination immediately was found to be suffering from shock and injury to right hind limb. He was given 15 minims of Inj. Ol. Camph and ordered to be kept quiet, with no solid food.

September 1st. A slight improvement manifest. The injury to the limb was diagnosed as fracture of the ischium. There was no inclination to run about, but restlessness was marked.

September 3rd. Urination difficult, the urine being tinged with blood. Hexamine gr. iij twice a day prescribed.

September 5th. No marked improvement.

September 10th. Breath very offensive and breathing rather laboured. Salol gr. v twice a day. Ruptured diaphragm suspected.

September 14th. Abdominal breathing pronounced, animal exhibited signs of pain on being lifted. Rupture of diaphragm diagnosed.

September 17th. X-ray photograph taken. Result disappointing, nothing abnormal being apparent, not even the fracture.

Breathing still mainly by the abdominal muscles. The animal on this day was more himself, except for a bout or two of pain.

September 20th. Animal quite lively and playful till the evening, when he cried out and died very shortly.

P.M. Examination.

The first noticeable feature of the case when the body was placed upon the table was the lack of bulk of the abdomen. On opening the cavity of the abdomen the first thing to spring into view, instead of the omentum was the liver, lying on the floor. The omentum, stomach and small intestine were not visible. It was at once seen that the diagnosis of " ruptured diaphragm " was correct, the organs not in sight having wandered into the thorax.

To ascertain the disposition of the displaced viscera in the thorax, the left chest wall was removed with the following result :—

The stomach dilated with gas was in the posterior part of the left side of the chest against the diaphragm. In front and below were the coils of the small intestine. The left lung, only about a tenth of its normal size, was situate above the intestine. The omentum and spleen were found in the right half of the thoracic cavity, and the right lung was equal to the left in size.

The rupture in the diaphragm was in the left half of the tendinous

centre, and was of considerable size. The edges were thickened, showing signs of an attempt at repair. The ischium was found to be broken obliquely at the base of the tuberosity.

Remarks.

This case illustrates the disappointment that may arise from an X-ray photograph. The ischial fracture was not revealed, though it was quite apparent during life. Nor was the abnormal position of the viscera made evident. If the dog had had a bismuth or barium meal before the radiation valuable information would have been forthcoming.

The length of time that the patient lived is interesting to note. It was evident from a careful examination that the rupture was caused directly by the accident, and it is probable that the viscera found their way, urged by the abdominal contractions, into the thorax more or less gradually. This piecemeal invasion of the chest accounted for the increasing severity of the respiratory symptoms.

Reviews

The Art of Milking. Professor A. C. Aggarwala, B.Sc. (Honours), M.R.C.V.S., Punjab Veterinary College. *Veterinary Bulletin*, No. 20. Published by the Department of Agriculture, Punjab.

In a small and well illustrated brochure entitled "The Art of Milking," Professor Aggarwala has set before his readers in India a clear picture of the advantages of carrying out the "Art of Milking" scientifically and properly, illustrating very lucidly that by adopting methods of cleanliness the economic value of the dairy cow can be very much increased in India—as has already been instilled into the agriculturist and dairy farmer of the West.

One very great difficulty, however, which does not occur in European countries, has to be contended with in India—and that is that, quoting from this little handbook, "An overwhelming majority of the population of the country holds the cow in extreme veneration and love purely on sentimental grounds, and owing to this the elimination of useless animals is rendered an impossibility. The result is that many millions of cattle are economically unprofitable, and mean a heavy drain on the resources of the people. On a rough estimate there are about 15,000,000 cattle which are useless and of no value whatever. If the life of these animals is taken at five years, and the value of food consumed each at Rs. 10 per annum, the total money spent apparently, without any profit, would amount to Rs. 750,000,000 annually. . . . It is not the cow that is keeping the people, but the people who are keeping her; whereas the reverse should be the case."

This paragraph expresses a difficulty which is not met with amongst European nations, and pioneers such as Professor Aggarwala who wish to introduce modern agricultural methods of dairying into India are "up

against it." However, nothing was ever done without hard work and opposition, and if only those who are carrying out dairying methods in India can be induced to follow out the modern methods mapped out in this little brochure, not only will the dairying industry benefit (to their advantage pecuniarily, as well as in other ways), but the presence of disease will be lessened, thus benefiting the pockets of the owners as well as the cattle themselves.

Aids to Dispensing. A. O. BENTLEY, Ph.C., Director of the Department of Pharmacy, University College, Nottingham. Pp. vi+200, with 7 figures in the text. London: Baillière, Tindall & Cox. Price 3s. 6d. net.

A SMALL handbook comprising 200 pages. The book, whilst essentially prepared for students of the Pharmaceutical Society, will be found of great value to both veterinary students and practitioners.

All branches of dispensing are dealt with, and the paragraphs being short and concise the book becomes easily readable.

The chapters dealing with powders and mixtures will greatly assist clean and accurate dispensing, whilst those on the preparation of percentage solutions, and sterile solutions for hypodermic injection, are very simply explained; and are always handy for reference.

The subject of chemical incompatibility is dealt with fairly fully, but at the same time in a very practical manner. Reference to this book will assist the busy dispenser.

Having been written to meet the requirements of the medical dispenser, such things as horse balls and other essentially veterinary preparations are not included; at the same time ointments, plasters, pills, etc., are dealt with fully.

The chapter dealing with emulsifying agents is instructive.

We strongly recommend this little book to practitioners, and think it is one which no Class C and D student should be without.—J.G.W.

Personal

LT.-COL. H. A. REID, O.B.E., F.R.C.V.S., D.V.H., has been appointed to represent New Zealand on the League of Nations Conference at Geneva, as Technical Specialist in the subject of the Inspection of Animals and Animal Products.

MR. JOHN G. WRIGHT, F.R.C.V.S., has been appointed to the Professional Chair of Pharmacology and Therapeutics in the Royal Veterinary College, London, in the place of Professor Smythe, whose resignation was recently caused by the severe illness, and subsequent death, of his father, Mr. D. Smythe, of Falmouth.

Professor Wright, who was a graduate of the London College, had a very distinguished college career, his honours including not only many first places in the medal list, but also first-class honours in the final examination, a very rare distinction.

THE MIDDLESEX COUNTY COUNCIL has appointed Capt. Sidney Villar, M.R.C.V.S., as County Veterinary Inspector under the Milk and Dairies (Consolidation) Act (1915), and the Milk and Dairies Order of 1926. The appointment is worth £750 together, with an allowance of £200 a year as motor allowance, and rises by annual increments of £25 to £900.